# RESPIRATORY PROTECTION PROGRAM
# FOR
# FIRE INVESTIGATORS & EVIDENCE TECHNICIANS

EXECUTIVE DEVELOPMENT

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An applied research project submitted to the National Fire Academy
as part of the Executive Fire Officer Program

October 2000

*Appendices Not Included. Please visit the Learning Resource Center on the Web at http://www.lrc.fema.gov/ to learn how to obtain this report in its entirety through Interlibrary Loan.*

## ABSTRACT

The problem identified for this research project was that the City of Lubbock Fire Marshal's Office did not have a program for its investigators and evidence technicians addressing the use of respiratory protection for a fire scene investigation. The purpose of this project was to develop a Respiratory Protection Program to serve as a guide for the investigators and evidence technicians of the City of Lubbock Fire Marshal's Office to use during a fire scene investigation.

Action research was the method used to answer the following questions: Do other fire investigation agencies have respiratory protection programs in place for their fire investigators? What types of respiratory hazards are present during a fire investigation? What type of respiratory protection is available?

Procedures that were used to complete this research project included reviewing current literature, visiting pertinent Internet sites, and interviewing qualified professionals.

The results of the project determined that a respiratory protection program was needed and action was taken to develop the program. It was determined through the research that no one organization had a complete respiratory protection program specifically directed toward fire investigators. It was determined through the research that there were numerous toxins present during a fire scene investigation.

It was recommended that the City of Lubbock Fire Marshal's Office should implement the Respiratory Protection Program that was developed through this research. It was also recommended that other agencies, which provide fire investigation services, should evaluate their policies and procedures associated with respiratory protection and develop a program that will cover the safety and welfare of their employees.

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## INTRODUCTION

The City of Lubbock Fire Marshal's Office is the Fire Prevention Division of the Lubbock Fire Department. It has nine career civil service positions and two non-civil service positions. All of the individuals within the Fire Marshal's Office are full-time employees. Each of the civil service positions within the division are responsible for the effective and efficient performance of fire inspections, fire investigations, life safety education, and they also serve as storm spotters during severe weather events.

Fire investigation division is comprised of four teams with two members on each team. Each team member is a peace officer and certified fire/arson investigator. The team members take distinctive roles in the investigation process. One team member is the lead investigator, whose primary responsibilities are case management, interviewing witnesses, scene evaluation and preparation of the official report. The other team member is the evidence technician, whose primary responsibility is the collection of evidence. This would include photographing the scene, drawing scene diagrams, collecting and bagging critical pieces of evidence and maintaining the property room. Both members of the team work together to systematically process the fire scene. This requires both team members to work in a scene that has been damaged by fire and has a considerable amount of dangerous by-products of combustion.

The problem prompting this research project is the fact that the City of Lubbock Fire Marshal's Office did not have a program for its investigators and evidence technicians addressing the use of respiratory protection for a fire scene investigation.

The purpose of this project was to develop a Respiratory Protection Program to serve as a guide for the investigators and evidence technicians to use during a fire scene investigation.

Action research methodology was used to develop the program. The following research questions to be answered are:

1. Do other fire investigation agencies have respiratory protection programs in place for their fire investigators?
2. What types of respiratory hazards are present during a fire investigation?
3. What type of respiratory protection is available?

## BACKGROUND AND SIGNIFICANCE

The investigators and evidence technicians for the City of Lubbock Fire Marshal's Office (LFMO) work in a variety of different environments while investigating fire scenes. They are regularly exposed to extremes in weather conditions, unfamiliar surroundings, by-products of combustion, airborne irritants and various other health and safety hazards.

For many years the fire service, particularly the fire investigation units, have disregarded the associated health risks with fire scene investigations. The major focus of concern was directed more toward the suppression and overhaul side of firefighting with little emphasis on the fire investigation process. Protective fire suppression gear, such as self-contained breathing apparatus, eye protection, hand protection, and foot protection have been the standard for many years. The fire service has learned through evaluation of fire scene injuries and deaths that there is a necessity for protective gear for fire suppression personnel based on the acute dangers associated with the extinguishment and overhaul of a fire. Unfortunately, little attention has been given to the chronic nature of illnesses associated with fire scene investigation.

There has been a recent push nationally for stricter rules and standards for the protection of individuals working in hazardous atmospheres, but the profession of a fire investigator has

been slow to respond. This push has been made by the National Institute for Occupational Safety and Health (NIOSH), the Occupational Safety and Health Administration (OSHA), the National Fire Protection Association (NFPA), and the United States Fire Administration (USFA).

It has been standard practice for investigators with the Lubbock Fire Marshal's Office to work fire scenes with coveralls, workboots, gloves (rubber or leather depending on the circumstance) and a hard hat. It wasn't until recently that any concern was given for the atmospheric conditions within the fire scene during salvage and overhaul and fire scene investigation. Many of the investigators within the office have experienced sinus problems, allergies, headaches and fatigue following investigations. While these symptoms lean more toward the acute nature of digging through the ashes and debris, there has to be a major concern on what the long term or chronic effect has on the investigators. There is too much information out in the health field that supports the idea that long term affects such as cancer, asthma, bronchial damage and various other respiratory chronic ailments will be present if precautions are not taken.

Recent purchases and policies have added air-monitoring devices to determine the amount of carbon monoxide present after the fire has been extinguished. This assists in determining when the use of self-contained breathing apparatus (SCBA) can be discontinued, but short of that, no program had been established to protect the investigator from the airborne contaminants that are present during fire scene evaluation. Requests for respiratory protection, even in the form of dust masks, were denied or delayed. This reaction or paralysis appeared to be based on apprehension of the manager of being legally liable if he provided the wrong respirator or filter. There was just a lack of understanding on what was needed.

Improvements in technology have led to respiratory protection devices that far surpass the old dust mask or rag tied around the face. Technology advancements have led to the discovery of many different hazardous airborne elements, which in turn provides the respiratory protection companies specific criteria for developing filters and masks to meet most every need.

As fire service managers, we are charged with the responsibility of ensuring the safety and welfare of the investigators that work in these hazardous conditions. Technology and information is available to aid fire service managers in developing protocols for fire scene investigation and every effort should be taken to implement sound policies and programs.

Developing policies and programs for employee safety and welfare directly relates to the *Legal Issues* chapter listed in the *Executive Development* (1998) course guide written by the National Fire Academy. The course guide states that it is necessary for the fire service manager to understand the basic legal issues associated with the fire service. The two basic legal issues directly associated with the development of a respiratory protection program is the overall safety and well-being of the fire investigator as well as the personal and organizational liability for not providing a safe working environment.

## LITERATURE REVIEW

The literature review for this project provided a focus on various issues related to the health and welfare of a fire investigator. This information gathered from personal interviews, articles, journals, textbooks and technical documents was evaluated and the relevant sites were included in this review. The review will be divided into four separate areas: compliance with nationally recognized standards, understanding the hazards, other departmental procedures, and essential steps for developing a respiratory protection program.

## Compliance with Nationally Recognized Standards

The literature review revealed a number of nationally recognized standards, practices, and recommendations on the safety and welfare of employees as well as fire investigators. Standards, recommendations, and reports such as NFPA Standard 921, the OSHA Standard 29 CFR 1910.134, the OSHA Technical Manual, Section VII, Chapter 2, the USFA's investigation handbook, and the NIOSH Health Hazard Evaluation Report, HETA 96-0171-2692 focused on the relevant topics of respiratory hazards and procedures.

### National Fire Protection Association, Standard 921

> The investigator should be cognizant of factors associated with chemical, biological, radiological, or other potential hazards that may threaten personal health and safety while conducting fire scene examinations. Where these conditions exist, special precautions should be taken as necessary. Special equipment such as rubber gloves, specialized filter masks or self-contained breathing apparatus, or hazardous material suits may be required (NFPA, 1998, n.p.).

This statement is very relevant to the project due to the fact that it is really the only nationally recognized standard found directly relating the need for respiratory protection to the field of fire investigation. NFPA Standards serve as a recommendation for the fire service unless the standards are specifically adopted into local ordinance. NFPA 921 is the leading standard across the nation for fire investigators to follow during fire scene investigations. This standard presents a systematic approach to fire investigation with safety being one of the primary elements.

**Occupational Safety and Health Administration, Standard 29 CFR 1910.134**

OSHA, which is under the U.S. Department of Labor, has established OSHA Standard 29 CFR 1910.134. This standard directly lists the respiratory protection requirements for employees working in dangerous environments.

> In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepting engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to this section (OSHA, 1998b, p. 1).
>
> Respirators shall be provided by the employer when such equipment is necessary to protect the health of the employee. The employer shall provide the respirators, which are applicable and suitable for the purpose intended. The employer shall be responsible for the establishment and maintenance of a respiratory protection program, which shall include the requirements outlined in paragraph (c) of this section (OSHA, 1998, p. 2).

Paragraph (c) outlines the elements of a respiratory protection program. Although the Lubbock Fire Department is not directly bound by the OSHA Standards by state law, this section of the OSHA Standard puts forth a nationally recognized statement that should be set as a guideline for all fire departments to follow.

While the OSHA Standard 29 CFR 1910.134 does not specifically give direction to fire investigators, it in conjunction with NFPA 921 sets the fundamental foundation on which this project was developed.

**OSHA Technical Manual**

> Wearing respiratory protective devices to reduce exposure to airborne contaminants is widespread in industry. An estimated 5.0 million workers wear respirators, either occasionally or routinely. Although it is preferred industrial hygiene practice to use engineering controls to reduce contaminant emissions at their source, there are operations where this type of control is not technologically or economically feasible or is otherwise inappropriate (OSHA, 1998c, p.1). Since respirators are not as consistently reliable as engineering and work practice controls, and may create additional problems, they are not the preferred method of reducing exposures below the occupational exposure levels. Accordingly, their use as a primary control is restricted to certain circumstances. In those circumstances where engineering and work practice controls cannot be used to reduce airborne contaminants below their occupational exposure levels (e.g., certain maintenance and repair operations, emergencies, or during periods when engineering controls are being installed), the use of respirators could be justified to reduce worker exposure. In other cases, where work practices and engineering controls alone cannot reduce exposure levels to below the occupational exposure level, the use of respirators would be essential for supplemental protection (OSHA, 1998, p. 1).

This portion of the OSHA Technical Manual appears to speak indirectly to the situation of fire investigation. It gives a general overview stating the need for engineering controls, but in situations where those engineering controls are not available, respirators should be provided to fill the need for protection. This is directly relevant to the nature of fire investigation since most of the fire scenes are different and no engineering controls can be consistently used.

**United States Fire Administration (USFA)**

> In recent years, increased awareness of the hazards to firefighters has produced significant improvements in personal protective equipment. However, the hazards to fire investigators are often given inadequate consideration. Just because the fire is out does not mean the hazard has passed (USFA, 1993, p. 5).

This statement relevantly shows that even as far back as 1993, the hazardous nature of fire investigation was understood, but not adequately considered by most departments to be a major concern.

**National Institute for Occupational Safety and Health (NIOSH)**

> Kinnes and Hine (1998) had the following conclusion:
>
> Although the environmental sampling conducted during this investigation indicated that most contaminant concentrations did not exceed the relevant evaluation criteria, it still indicated that the potential for exposure exists. In addition, the sampling indicated that the potential for exposure to carcinogens existed to some extent. Exposures to formaldehyde concentrations, which exceeded the NIOSH ceiling limit of 0.1 ppm and to several PAHs (which are suspected of having carcinogenic potential in humans) were observed (Kinnes and Hine, 1998, p. 12).

This indicates that both acute and chronic exposures to fire investigators are of concern. The report written by Kinnes and Hine was a health hazard evaluation of two separate fire scenes in 1997 under the direction of the Bureau of Alcohol, Tobacco, and Firearms (ATF). Two of the four recommendations given by Kinnes and Hines (1998) included that "the ATF should require their investigators to wear appropriate respiratory protection when performing fire scene investigations" and "the ATF should establish a respiratory protection program for their fire investigators and ensure that it complies with the requirements described in 29 CFR 1910.134" (p. 12). This report is very significant to this project since it is a study done by a nationally recognized institution for the ATF. NIOSH determined through significant scientific evaluation, the dangers associated with fire scene investigation. The specific dangers will be listed later in this literature review.

**Understanding the Hazards**

> Since most environmental toxins enter the body via the respiratory tract, it is not surprising that injury to this system is the most common of all injuries to internal organs. Every fire scene has a large concentration of environmental toxins therefore; it must be imperative to reduce the amount of toxins that enter the body through the respiratory system (Rosenstock and Cullen, 1986, p. 305).
>
> Firefighters face many health hazards, including: inhalation of a wide variety of toxic combustion products; chemical exposures by direct skin and eye contact; physical hazards, including heat, cold, noise, and falling objects; and exposure to carcinogenic chemicals or combustion products. In over 200 residential fires in Boston, air monitoring (which focused on a small fraction of the possible combustion products) found varying air concentrations of carbon monoxide,

> carbon dioxide, hydrogen cyanide, benzene, nitrogen dioxide, hydrogen chloride, and acrolein. Other toxic components of smoke can include ammonia, acrylonitrile, halogen acids, sulphur dioxide, aldehydes, isocyanates, methylene chloride, particulates, and hydrocarbons. It continued in this report to state that exposure to respiratory irritants such as acrolein, hydrogen chloride, and nitrogen dioxide may lead to acute and chronic respiratory problems. Disability to pulmonary disease has long been recognized as a potential work-related hazard for fire fighters. There is increasing concern about a firefighter's exposures to carcinogens released from the combustion of synthetic materials used in building construction (Kinnes and Hines, 1998, p. 7).

This NIOSH report explained in detail how each toxin listed below was present in each of the fire scenes and the significant dangers associated with fire investigation activities.

Koff stated that "Occupational lung disease currently ranks as the number one health threat to American workers. To combat this threat, industrial health and safety professionals have focused their efforts on preventive technology - particularly, respiratory protection equipment"(p. 34). Lung disease will increase for fire investigators if the dangers associated with fire scenes are not recognized. Geraci recognized the fundamental dangers in the following statement:

> Hazards to an investigator's health lurk at every fire scene, since hazardous materials can be found in every occupancy, regardless of its type and use. By knowing the potential hazards, investigators can avoid the actual hazards. Hazardous materials created by the fire, or by exposure to the fire, can be solid, liquid or gas, and each has its own unique

> hazards. Exposure can occur by inhalation, ingestion, injection or absorption (Geraci, 1997, p. 52).

All of these exposures can be guarded against by personal protective equipment. Both Koff and Geraci give strong statements to the necessity of providing respiratory protection for investigators.

According to North (1989), "the big four occupational health risks associated with respiratory disease are asbestos, silica, lead and carbon dioxide" (p. 40). North also stated that inhaled contaminates that adversely affect the lungs fall into three categories:

1) Particulates that, when deposited in the lungs, may produce tissue damage, tissue reaction, disease, or physical obstruction. Dusts, aerosols, fumes and fibers. Lead fumes, asbestos fibers and free silica dusts belong in this category.

2) Toxic gases, such as hydrogen fluoride, that directly affects lung tissue, and vapors - a vapor is the gaseous state of a substance that is normally mostly liquid at room temperature. Many solvents evaporate and become vapors.

3) Toxic gases or aerosols that do not affect the lung tissue, but are passed from the lung into the bloodstream, where they are carried to other body organs or have adverse affects on the oxygen-carrying capacity of the blood stream. North stated that Pneumoconiosis is caused by dust inhalation (North, 1989, p. 40).

Two of the most common forms of pneumoconiosis are asbestosis and silicosis, both of which cause acute as well as chronic symptoms. Both have been shown to have a contributory affect to possible cancers of the stomach, colon and rectum (North, 1989, pp. 40-41).

According to Moisan (1991) "the development of asthma and asthmalike syndromes after high-dose irritant exposure has been recognized with increasing frequency since the description of the reactive airways dysfunction syndrome by Brooks et al" (p.458). Moisan goes on to say that:

> Today, fire fighters and fire victims are exposed to a vast array of toxic inhalants from the combustion and pyrolysis of both natural and synthetic materials…. It is likely that the induction of airways hyper-responsiveness and the asthmatic state following a single high-dose exposure to pyrolysis products is due to airway inflammation caused by one or more toxic inhalants (Moisan, 1991, p. 458).
>
> Moisan also states that firefighters and smoke inhalation patients share the common risks of multiple, unpredictable, and difficult-to-quantify exposure to toxic inhalants. Ammonia, acrolein and other aldehydes, $SO_2$, $NO_2$, HF, reactive oxygen species, phosgene, HCl, and isocyanates have been found in the pryolysis and partial combustion products of various natural and synthetic materials (Moisan, 1991, p. 460).

It is very common for fire investigators to be exposed to the same products as both the firefighters and fire victims. The majority of fire investigations are done in one and two family dwellings. Furniture, bedding, clothing, and window coverings are instrumental in provided the fire load necessary to produce the dangerous gases. Fire victims are present during the incipient and smoldering phase of the fire, where the majority of smoke is generated. This effect is reduced slightly through overhaul and ventilation, but the dangerous gases are still in the ashes and are released as the fire investigators dig. Respiratory protection is needed when there is a possibility of toxic gases present.

**Other Departmental Procedures**

Interviews conducted with the Phoenix Fire Department, the Bureau of Alcohol, Tobacco & Firearms and the Texas State Fire Marshal's Office under the direction of the Texas Department of Insurance revealed departments and agencies that fell into one of three categories: one department did not have a policy or procedure; one agency understood the need for a policy and had a temporary policy; and one agency fully understood the nature of the hazards and had just completed development of a respiratory protection program.

According to L.B.Bushong (personal communication, June 26, 2000), the Phoenix Fire Department does not have a respiratory protection program for fire investigators. He stated that while they were a very progressive department and understood the inherent dangers associated with investigating a fire scene, no written program had been established.

According to K. Thornton (personal communication, June 26, 2000), the Bureau of Alcohol, Tobacco, and Firearms has Special Agents that work across the nation as Certified Fire Investigators (CFI's). ATF instituted a health-screening program for the CFI's to have regular checkups. After the program was implemented, it was determined that two of the investigators had bladder cancer. It was determined that neither of these two investigators had worked together. The doctor working the case felt that it was rare for two people in their 30's to both have bladder cancer, be associated with the same agency and had never worked together. This concern led to a request for NIOSH to perform a health hazard evaluation (HHE) in 1997 of fire scenes where ATF would be performing investigations. The NIOSH Health Hazard Evaluation Report, HETA 96-0171-2692, was described in an earlier section of this project. K. Thornton stated that after the report, ATF determined that the health and safety of its CFI's were at risk and additionally the agency had a liability risk. This led to an interim policy on respiratory

protection dated June of 1999. The statement made by K. Thornton as to the liability issue is very significant. While it is very important (and in some instances a legal requirement) to protect the safety and welfare of the employee, it also becomes a liability issue on the agency if no action is taken.

The Texas State Fire Marshal Office, which in under the Texas Department of Insurance, has taken a very proactive approach by reviewing the need for a respiratory protection program. The credit can be given to Richard Beals with the State Fire Marshal's Office for his extensive work on recognizing the problem and developing a program that could be implemented. The Respiratory Protection Program developed by Mr. Beals was used as a template for the City of Lubbock Fire Marshal's Office Respiratory Protection Program and HAZCOM Policy. According to R. Beals (personal communication, June 27, 2000), the State had a considerable amount of liability by not having a program and it would be just a matter of time before the effects of exposure to the investigators would start to take its toll. Mr. Beals' program was submitted for review on May 5,2000, and is waiting approval.

**Essential Steps for Development of a Respiratory Protection Program**

According to Lab Safety Supply, step one is to develop a respiratory protection program according to 29 CFR 1910.134. The written program shall include the following elements: selection process, medical evaluations; fit testing; procedures for use; procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing and discarding; procedures to ensure air quality, quantity and flow; training in respiratory hazards; training in use limitations and maintenance and procedures for regularly evaluating the effectiveness of the program (Lab Safety Supply, 2000, pp. 1-2).

> There is virtually no single respirator that protects against all contaminants and concentrations. Therefore, you must match expected respirator-protection needs with the protection offered by various respirator models. To help in the proper selection, NIOSH information accompanies each approved respirator (Dessoff, 1995. p. 57).

There are two types of respirators available for investigators: air-purifying and supplied air. Fire investigators should not be allowed into scenes that are oxygen deficient, therefore, air-purifying respirators will be the respirator of choice. Dessoff (1995) also states that "air-purifying respirators for particulates have replaceable filters. Those that protect from gas, fume or vapor hazards come with a replaceable cartridge or canister that reacts to reduce the specific contaminants. It is important to select the right cartridge" (p. 57).

> The employer shall provide a medical evaluation to determine an employee's ability to use a respirator. This shall occur before the employee is fit tested or required to use the respirator in the workplace…. Medical evaluations by a physician or licensed Health Care Professional (HCP) must be done prior to fit testing or use. Follow-up medical examinations are necessary if any positive responses are revealed by the initial exam, or as considered necessary by the HCP (Lab Safety Supply, 2000, p. 4).

OSHA's Standard 29 CFR 1910.134 specifically lists all the requirements for fit testing, use of respirators, maintenance and care, breathing air quality and use, identification of filters, cartridges and canisters, training and information, program evaluation, and recordkeeping.

OSHA's fit testing standard is very specific on what is required during the fit testing process, but according to Sheppard, "although comfort is not a NIOSH requirement, it is

extremely important. If the respirator does not feel comfortable, the wearer may influence the effectiveness of the respirator, while trying to adjust it" (p. 69). It is also stated in Sheppard's article, “Trainers should also be able to address any fears and anxieties the respirator wearers might have,” says McKay. “People can become fearful that their respirator is not working properly if it does not fit comfortably" (p. 69).

According to G. Stevens (personal communication, May 22, 2000) with Scott Aviation, fit testing for half mask respirators must be fit tested according to OSHA Standard 29 CFR 1910.134 and ANSI Standard Z88.2-1992.

According to R. Beals (personal communication, June 27, 2000) the Texas State Fire Marshal's office chose the MSA, Comfo-classic, half mask respirator. They looked at the protection factors and determined that due to the absorption of toxins through the mucus membranes of the respiratory system, and the fact that their investigators would not be allowed into atmospheres that were immediately hazardous to life and health (IDLH), led them to the conclusion that a half-mask air-purifying respirator would meet their needs.

In summary, the national standards recognize the dangers associated in industry and with emergency workers, but not all agencies in the field have developed the procedures and policies necessary to see that employees performing fire investigations are protected. The atmospheres in a fire scene have concentrations of toxic and hazardous gases that will significantly impact the health and welfare of the investigator at the fire scene and there are respiratory protection devices available provide that protection.

## PROCEDURES

The purpose of this project was to develop a Respiratory Protection Program to serve as a guide for the investigators and evidence technicians to use during a fire scene investigation.

Through the steps of reviewing current literature, visiting pertinent Internet sites, and interviewing qualified professionals, it was determined that a respiratory protection program was needed and action was taken to develop the program.

**Reviewing Current Literature and Web Sites**

A literature review began at the National Fire Academy's Learning Resource Center (LRC) in April of 2000. Articles obtained from the LRC found in various literary sources were directly related to the areas of respiratory protection and available options, fire scene hazards, studies that identify specific risk factors, industrial hazards, and program development. Documents found in the library of the City of Lubbock Fire Marshal's Office from the USFA and the NFPA were also reviewed. A copy of excerpts from a medical book was provided (personal communication, August 22, 2000), to this author for review from Physician Assistant Tom Moran, who is associated with Covenant Medical Hospital in Lubbock, Texas.

The Internet was used to access OSHA's web site for the Technical Manual and Standard 29 CFR 1910. Internet access also allowed this author to visit the Lab Safety Supply site for helpful hints on program development.

The Texas State Fire Marshal's Offices' proposed respiratory protection program provided by R. Beals was also evaluated and used as a template for the City of Lubbock Fire Marshal's Office Respiratory Protection Program found in the Appendix A of this project.

**Personal Interviews**

Personal interviews, telephone interviews and written correspondence were used to determine if a respiratory protection program was needed and to develop the program. Telephone interviews were conducted with Greg Stevens, Kelton Thornton, Chief Robert J. Cantwell, L.B. Bushong, and Richard Beals.

The interview with Greg Stevens, who is in the technical support division of Scott Aviation, was conducted on May 22, 2000 with the main focus of the discussion centered on fit testing requirements for half-mask respirators.

Kelton Thornton, who is the Regional Agent in Charge (RAC) in Dallas, Texas, for the Bureau of Alcohol, Tobacco & Firearms (ATF), was interviewed by telephone on June 26, 2000. Mr. Thornton (personal communication, June 26, 2000) discussed studies from the Phoenix Fire Department and NIOSH regarding respiratory protection. Mr. Thornton gave this author the name of Richard Beals with the Texas State Fire Marshal's office because he knew that Mr. Beals had just gone through the process of developing a respiratory protection program for the State Fire Marshal's Office. Mr. Thornton also stated in this interview that the ATF had developed a temporary respiratory policy and Mr. Beals had a copy of that policy.

On June 26, 2000, Fire Chief Robert J. Cantwell, of the Phoenix Fire Department, Phoenix, Arizona, was called by this author to determine if his department had a respiratory protection program. Chief Cantwell (personal communication, June 26, 2000) stated that "he would have someone from his department send a copy of the policy or return this call." L.B. Bushong, who is a member of the Phoenix Fire Department, return this author's telephone call on June 26, 2000. Mr. Bushong (personal communication, June 26, 2000) stated that "they did not have a written respiratory policy."

On June 27, 2000, Richard Beals, who is an Investigation Supervisor for the Texas State Fire Marshal's Office, was interviewed by telephone. The interview focused on his involvement in the development of a respiratory protection program for his agency. Mr. Beals (personal communication June 27, 2000) stated that he would send a copy of his program to this author. Mr. Beals delivered his respiratory protection program to this author's office on July 20, 2000,

and a personal interview was done regarding the steps taken to develop the program. There was an in-depth look at the actual document itself during this meeting.

On August 22, 2000, a personal interview was done with Tom Moran, who is a Physicians Assistant for Convenant Occupational Medicine Service in Lubbock, Texas. Questions involved the necessity of performing pulmonary function tests, hearing tests, general overall physicals and the OSHA Medical Questionnaire. Mr. Moran (personal communication, August 22, 2000) stated that the pulmonary function test was necessary to make sure that the individual would be able to wear an air-purifying respirator or supplied-air respirator. The overall function of the respiratory tract was important for two reasons; 1) They need to find out if there is any preconditions such as obstructions or restrictions that would prohibit the use of a respirator and, 2) to determine a base line for the individual to determine if there is any future damage. Mr. Moran also stated that hearing tests were done to see if any damage has been done to the eardrum. If the eardrum is damaged or perforated, there is a potential for toxins to enter the respiratory tract at that location, even though the user is wear a respirator over their mouth and nose. The general physical evaluated cardiac health, the ability to bend and lift and any other health related issues that may be found during the examination. Mr. Moran stated that the cardiovascular check-up was important since some heart disease may show symptoms similar to respiratory dysfunction and high blood pressure could be aggravated when an employee does strenuous work in a respirator.

Other interviews were performed with Lt. Michael Lewis, District Chief Lewis Treadwell, and Lt. Bryce Daniel, who are employees for the City of Lubbock Fire Department to determine if there was a respiratory protection program in place, if there was a written fit testing procedure in place and what training was available for wearing respirators in hazardous

locations. These interviews were done over the telephone in June 2000 and August 2000. It was determined through these interviews that there was not a written respiratory protection program for the Lubbock Fire Department. Fit testing procedures were being performed according to 29 CFR 1910, and HAZMAT training could be provided from the Department's Training Academy.

The author found no existing contributing factors that would limit the development of a respiratory protection program for the City of Lubbock Fire Marshal's Office. The upper management within the Fire Department was more than willing to provide the funding for respirators, filters and health screenings. The main objectives would be to develop the program, choose the respirator, provide health screenings and pulmonary tests, and require fit testing and training. The program will be evaluated on an annual basis and employee usage will be regularly evaluated. Annual fit testing, health screenings, training, and pulmonary tests will be provided to monitor the employee's well being.

## RESULTS

**Do other fire investigation agencies have respiratory protection programs in place for their fire investigators?**

It was determined through the research that no one organization had a complete respiratory protection program specifically directed toward fire investigators. ATF had an interim policy on respirator use and the Texas State Fire Marshal's office had a full program in review, but both the author's department and the Phoenix Fire Department had no written respiratory protection policy for fire investigators. No student questioned in the Executive Development class of April 2000 had a respiratory protection program written for their fire investigators.

**What types of respiratory hazards are present during a fire investigation?**

It was determined through the research that there were numerous toxins present during a fire scene investigation. Through all the interviews and literature reviews there was a significant amount of information available that indicated the dangerous nature of breathing the air during a fire investigation, but none were as convincing as the NIOSH Report performed for ATF. In the NIOSH Report, it was determined that:

Air concentrations of carbon monoxide, carbon dioxide, hydrogen cyanide, benzene, nitrogen dioxide, hydrogen chloride, and acrolein were present. Other toxic components of smoke found included ammonia, acrylonitrile, halogen acids, sulphur dioxide, aldehydes, isocyanates, methylene chloride, particulates, and hydrocarbons. It continued in this report to state that exposure to respiratory irritants such as acrolein, hydrogen chloride, and nitrogen dioxide may lead to acute and chronic respiratory problems (Kinnes and Hines, 1998). Other documents in the literature review included respiratory diseases such as pneumoconiosis, which includes asbestosis and silicosis. Both of these diseases have acute as well as chronic affects on the respiratory system including, but not limited to asthma, airway inflammation, and cancers.

**What type of respiratory protection is available?**

There are two common types of respiratory protection devices available to the consumer. First, the air-purifying respirator is equipped with either a full face-piece or half-mask. Both are equipped with a filter or canister, which filters out the dust, mist, aerosols, and fine particulates in a hazardous atmosphere. Second is the supplied-air respirators, which are used in atmospheres that are oxygen deficient or in atmospheres where the toxicity level of the atmosphere exceed the manufactures limitations on the filters or canisters.

One of the main elements of this project was to develop a respiratory protection program (RPP) for the City of Lubbock Fire Marshal's office (Appendix A). The RPP includes definitions of terminology used in the RPP, a stated purpose of the program, the background associated with the program and defines who the program administrator is and their duties. The program also lists how the respirators are selected, the procedures for employee medical evaluations, as well as the fit testing requirements. Issuance of the respirators and filters are listed and training guidelines are established. When the respirators are to be used, as well as how they are to be maintained are listed in the program. The program provides for systematic evaluation and proper recordkeeping of the appropriate documentation. A copy of OSHA Standard 29 CFR 1910.134 and it appurtenant sections are included, as well as a written policy for implementation of the program. Manufacturer's documentation is provided for the filters and the respirators to be used in the department. Finally, proper forms are provided for documentation of the medical evaluations, the physician's advisory, the fit testing and the respirator use.

## DISCUSSION

All of the research done during this project supports the idea that a respiratory protection program for fire investigators is needed. Fire investigation as an industry has been very slow to develop health related policies and procedures to protect its employees. It is very disturbing to find out how little information was available that directly associated the need for respiratory protection to fire investigation. The need for a respiratory protection program was supported by the following issues: (a) atmospheres within a fire scene have considerable acute and chronic health hazards that will be detrimental to the fire investigator, (b) considerable moral and legal implications are present, and (c) the health and safety of employees could be greatly improved.

The most significant issue indicating a need for a respiratory program would be the acute and chronic ailments associated with breathing the toxic air in a fire scene. Fires and explosions often generate toxic or noxious gases. The presence of hazardous materials in the structure is certain. Homes contain chemicals in the kitchen, bath, and garage that can create great risk to the investigator if he or she is exposed to them. Commercial and business structures are generally more organized in the storage of hazardous materials, but the investigator cannot assume that the risk is less in such structures. Many buildings older than 20 years will contain asbestos. The investigator should be aware of the possibility that he or she could become exposed to dangerous atmospheres during the course of an investigation. (NFPA, 1998) According to USFA, (1993), the fireground only becomes marginally less hazardous after the fire is out, and fire investigators must recognize and protect themselves from many of the same hazards as firefighters. USFA goes on to say that these include the hazards of acute exposures which may incapacitate an investigator immediately and those which produce chronic or long-term health effects which produce gradual debilitation.

> Airborne (or respiratory) hazards may result from either an oxygen deficient atmosphere or breathing air contaminated with toxic particles, vapors, gases, fumes or mists. The proper selection and use of a respirator depend upon an initial determination of the concentration of the hazard or hazards present in the workplace, or the presence of an oxygen deficient atmosphere. Airborne hazards generally fall into the following basic categories:
>
> 1. Dusts - Particles that are formed or generated from solid organic or inorganic materials by reducing their size through mechanical processes such as crushing, grinding, drilling, abrading, or blasting.

2. Fumes - Particles formed when a volatilized solid, such as a metal, condenses in cool air. This physical change is often accompanied by a chemical reaction, such as oxidation. Examples are lead oxide fumes from smelting, and iron oxide fumes from arc-welding. A fume can also be formed when a material such as magnesium metal is burned or when welding or gas cutting is done on galvanized metal.

3. Mists - A mist is formed when a finely divided liquid is suspended in the air. These suspended liquid droplets can be generated by condensation from the gaseous to the liquid state or by breaking up a liquid into a dispersed state, such as by splashing, foaming, or atomizing. Examples are the oil mist produced during cutting and grinding operations, acid mists from electroplating, acid or alkali mists from pickling operations, paint spray mist from spraying operations, and the condensation of water vapor to form a fog or rain.

4. Gases - Gases are formless fluids that occupy the space or enclosure and which can be changed to the liquid or solid state only by the combined effect of increased pressure and decreased temperature. Examples are welding gases such as acetylene, nitrogen, helium and argon; and carbon monoxide generated from the operation of internal combustion engines. Another example is hydrogen sulfide, which is formed wherever there is decomposition of materials containing sulfur under reducing conditions.

5. Vapors - Vapors are the gaseous form of substances that are normally in the solid or liquid state at room temperature and pressure. They are formed by

evaporation from a liquid or solid, and can be found where parts cleaning and painting takes place and where solvents are used.

6. Smoke - Smoke consists of carbon or soot particles resulting from the incomplete combustion of carbonaceous materials such as coal or oil. Smoke generally contains droplets as well as dry particles.

7. Oxygen deficiency - An oxygen deficient atmosphere has an oxygen content below 19.5% by volume. Oxygen deficiency may occur in confined spaces, which include, but are not limited to, storage tanks, process vessels, towers, drums, tank cars, bins, sewers, septic tanks, underground utility tunnels, manholes, and pits. (OSHA, 1998c, pp. 5-6)

Each of the above listed toxic hazards is found in one form or another in a fire scene. Even though these listed items directly relate to an industrial process, a fire investigator can and should expect possible similar exposures. Every fire investigator has experienced coughing, sneezing, allergic reactions, black mucous in the nasal passages, as well as headaches and nausea. These are all acute symptoms to toxic elements found in the fire scene. It is common for investigators to have cardiac, pneumonia, and bronchial problems. Some investigators have also died from cancers of the stomach and lungs. Why have we been so slow to protect our own? The facts are there to support the acute and chronic effects of toxic atmospheres and yet we are have been so reluctant to implement procedures that would reduce these effects. Moral and legal implications are present if no action is done. Moral issues are definitely intangibles that have no fundamental basis for policy making. But, if I know the dangers associated with my investigators breathing toxic by-products of a fire and if I ignore those issues, I have created a moral dilemma that will be with me forever. The legality of the issue is one that

can be debated amongst the laymen for years, but it will inevitably be decided in the civil courts. The City of Lubbock Fire Department, belonging to a municipality within the State of Texas, is not bound legally to the OSHA Standards. "Federal OSHA has no jurisdiction over the many firefighters who are state and local government employees or volunteers. Although OSHA has no jurisdiction over public sector (state and local government) firefighters, the 25 states operating OSHA-approved state plans do cover those workers" (OSHA, 1998a). Texas is not one of those OSHA-approved state plans. It is important to recognize that they are nationally recognized standards and any civil court jury will ask why did your agency not feel compelled to adhere to these standards in a reasonable and prudent manner. Ultimately, the courts will decide the issue.

> OSHA standards do not apply to state and local governments except in states that have voluntarily elected to adopt an OSHA State Plan. Consequently, the respiratory protection standard does not meet the definition of a "Federal intergovernmental mandate" (Section 421(5) of UMRA (2 U.S.C. 658(5)). Thus, the final respiratory protection standard does not impose unfunded mandates on state or local governments (OSHA, 1998a).

The general health and safety of the employee is very important in determining if a respiratory protection program is needed. If the employee is healthy and not suffering from headaches, allergic reactions, nausea, or fatigue, then he or she is able to finish the investigation and return to work. Sick leave usage is reduced, which helps the employer, as well as helping the employee. Acute symptoms are not only debilitating to the employee but they also serve as a source of frustration and increased anxiety. The employee is faced with the uncertainty of what is wrong, the increase in medical bills associated with medicine and doctor visits, and the overall

feeling of being worn out each and every day the symptoms are present. The chronic symptoms associated with cancer and other life threatening illnesses places an extreme amount of stress and pain on both the employee and his or her family.

The results of respiratory inhalation of toxins found at a fire scene are quite complicated and debilitating, but the solution is very simple. Based on all the research and documentation provided, it is obvious that something as simple as wearing a respirator could significantly decrease the chance of respiratory diseases. According to Geraci (1997), "the fire is gone, but the hazards linger on" (p. 51). Geraci also states that "a lot of this article contained common-sense precautions that investigators should take. But as with any profession, complacency exists more than we like to admit. In this profession that may mean an injury or exposure that will kill you in days, months or years later" (p. 54). Investigators and the fire service managers must take every precaution to make sure that the safety and welfare of all involved is the primary goal.

## RECOMMENDATIONS

Based on the research provided in this document, the following recommendations are made:

1. The City of Lubbock Fire Department should consider implementing the respiratory protection program developed by this author for the fire investigators assigned to the Fire Prevention division. The program addresses the major issues associated with respiratory protection and a policy has been developed for implementation. Implementing the program will enhance the safety and welfare of the department's employees.

2. Other agencies that provide fire investigation services should evaluate their policies and procedures associated with respiratory protection and develop a program that will cover the safety and welfare of their employees.

3. The United States Fire Administration, the National Fire Protection Association, the International Association of Firefighters, the International Association of Arson Investigators, and any other relevant associations should strive to bring the dangers associated to fire investigators to the forefront and on an equal plain with the dangers associated with firefighting. Necessary codes and regulations must be established that specifically relates the standards that OSHA has established and applied to industry to fire investigation. It has to be specifically spelled out and listed before the involved agencies will take notice.

4. It is recommended that investigators be trained in the usage of respirators and learn when a supplied-air respirator is required and when air-purifying respirators can be used. Based on the information available, it is recommended that investigators not enter into atmospheres that are considered to be immediately dangerous to life and health (IDLH). Investigators should not go into a fire scene until the fire suppression officer in charge has determined that the atmosphere is not IDLH and SCBA's are not needed. It is also recommended that fire investigators be issued half-mask respirators and appropriate filters and only perform investigations in situations where a half- mask air-purifying respirator can be used. Additional training must be given if supplied-air respirators are issued and used during investigations where an IDLH atmosphere is present.

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